DATA PROCESSING SYSTEM AND METHOD

Field of the Invention

5   The present invention relates in general to a data processing method and system.

Background to the Invention

10   In general terms, it is desired to assemble many small sections of raw audio and video content (i.e. sound clips and video clips) to form a finished audiovisual product, by way of an authoring process. However, in many environments a considerable degree of specialist knowledge

15   and time must be invested in the authoring process in order to achieve a desirable finished audiovisual product. These problems are exacerbated where the audiovisual product has a complex navigational structure or requires many separate raw content objects.

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       As a simple example, a feature movie or television program typically has a straightforward linear navigational sequence of individual scenes. By contrast, it is now desired to develop new categories of audiovisual

25   products which have a much more complex navigational structure, such as a movie with many scene choices or different movie endings, and/or which have a large number of individual scenes, such as an interactive quiz game with say one thousand individual quiz questions.

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       An optical disc is a convenient storage media for many different purposes. A digital versatile disc (DVD) has been developed with a capacity of up to 4.7Gb on a

single-sided single-layer disc, and up to 17Gb on a double-sided double-layer disc. There are presently several different formats for recording data onto a DVD disc, including DVD-video, DVD-audio, and DVD RAM, amongst

5   others. Of these, DVD-video is particularly intended for use with pre-recorded video content, such as a motion picture. As a result of the large storage capacity and ease of use, DVD discs are becoming popular and commercially important. Conveniently, a DVD-video disc is

10 played using a dedicated playback device with relatively simple user controls, and DVD players for playing DVD-video discs are becoming relatively widespread. More detailed background information concerning the DVD-video specification is available from DVD Forum at

15 www.dvdforum.org.

Although DVD-video discs and DVD-video players are becoming popular and widespread, at present only a limited range of content has been developed. In particular, a

20 problem arises in that, although the DVD specification is very flexible, it is also very complex. The process of authoring content into a DVD-video compatible format is relatively expensive and time consuming. In practice, the flexibility and functions allowed in the DVD-video

25 specification are compromised by the expensive and time consuming authoring task. Consequently, current DVD-video discs are relatively simple in their navigational complexity. Such simplicity can impede a user's enjoyment of a DVD-video disc, and also inhibits the development of

30 new categories of DVD-video products.

An example DVD authoring tool is disclosed in WO 99/38098 (Spruce Technologies) which provides an

interactive graphical authoring interface and data management engine. This known authoring tool requires a relatively knowledgeable and experienced operator and encounters difficulties when attempting to develop an audiovisual product having a complex navigational structure. In particular, despite providing a graphical user interface, the navigational structure of the desired DVD-video product must be explicitly defined by the author. Hence, creating a DVD-video product with a complex navigational structure is expensive, time-consuming and error-prone.

Current DVD-Video authoring tools use some form of user interface to define a project for producing a DVD-Video disc image, that is, for producing the data structures and navigation information for such a DVD-Video disc. Ultimately such authoring tools eventually multiplex the video, audio and sub-picture parts, that is, the DVD assets, in accordance with the DVD-Video specification and format the resulting files together with the associated navigation information to yield a DVD-Video disc image.

A significant limitation of prior art DVD authoring systems is that the authors must, or usually, use the same authoring tools for any given project. It will be appreciated that the situation is exacerbated if one contemplates creating a DVD or marshalling the assets to create a DVD-Video disc image using different authoring tools. Many authoring companies or facilities will use their preferred authoring tools. For example, a popular authoring tool is Scenarist available from Sonic Solutions. However, there are some aspects of the DVD

specification such as, for example, seamless branching, that the Scenarist authoring tool does not support. Therefore, if an authoring company or facility is asked to undertake a project for which seamless branching is required, they will have to either decline that project or use a specialist tool with which they might be unfamiliar to author the DVD-Video disc image. It will be appreciated by those skilled in the art that using such an alternative authoring tool could be expensive, time consuming and inefficient as the company may only have one person, or a small number of people, who are familiar with the specialist authoring tool.

It is an object of embodiments of the present invention at least to mitigate some of the problems of the prior art.

Summary of Invention

In a first aspect of the present invention there is provided an authoring method for use in creating an audiovisual product, comprising the steps of: defining a plurality of components, the components implicitly representing functional sections of audiovisual content with respect to one or more raw content objects, and a plurality of transitions that represent movements between the plurality of components; expanding the plurality of components and the plurality of transitions to provide a set of explicitly realised AV assets and an expanded intermediate data structure of nodes and links, where each node is associated with an AV asset of the set and the links represent movement from one node to another; and creating an audiovisual product in a predetermined output format, using the AV assets and the expanded intermediate

data structure of the nodes and the links, wherein the audiovisual product comprises data representing merged first and second video data. Preferably, the first and second video data are DVD-video zone data.

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In one preferred embodiment, the present invention relates to authoring of audiovisual content into a form compliant with a specification for DVD-video and able to be recorded on an optical disc recording medium.

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In a second aspect of the present invention there is provided an authoring method for use in creating a DVD-video product, comprising the steps of: creating a plurality of components representing parameterised 15 sections of audiovisual content, and a plurality of transitions representing movements between components; expanding the plurality of components and the plurality of transitions to provide a set of AV assets and an expanded data structure of nodes and links, where each node is 20 associated with an AV asset of the set and the links represent movement from one node to another; and creating a DVD-video format data structure from the AV assets, using the nodes and links, wherein the DVD-video format data structure comprises data representing merged first 25 and second video data. Preferably, the first and second video data are DVD-video zone data.

In a third aspect of the present invention there is provided an authoring method for use in creating an 30 audiovisual product according to a DVD-video specification, comprising the steps of: generating a set of AV assets each comprising a video object, zero or more audio objects and zero or more sub-picture objects, and an

expanded data structure of nodes and links, where each node is associated with one AV asset of the set and the links represent navigational movement from one node to another; and creating a DVD-video format data structure from the set of AV assets, using the nodes and links; the method characterised by the steps of: creating a plurality of components and a plurality of transitions, where a component implicitly defines a plurality of AV assets by referring to a presentation template and to items of raw content substitutable in the presentation template, and the plurality of transitions represent navigational movements between components; and expanding the plurality of components and the plurality of transitions to generate the set of AV assets and the expanded data structure of nodes and links, wherein the set of AV assets and the expanded data structure of the nodes and links comprises data representing merged first and second video data. Preferably, the first and second video data are DVD-video zone data.

In another aspect the present invention there is provided a recording medium having recorded thereon computer executable instructions for performing any of the methods defined herein.

In yet another aspect of the present invention there is provided a recording medium having recorded thereon an audiovisual product authored according to any of the methods defined herein.

Advantageously, embodiments can provide a convenient and simple method and apparatus for authoring an audio-visual product.

Preferred embodiments provide a method and apparatus able to create an audio-visual product having a complex navigational structure and/or having many individual content objects, whilst reducing a time required for authoring and minimising a need for highly skilled operators.

Preferably, there is provided an authoring tool that is intuitive to use and is highly flexible.

Particularly preferred embodiments support creation of audio-visual products such as DVD-video products that run on commonly available DVD-video players.

According to a further aspect of embodiments of the present invention there is provided a method for merging first and second data associated with first and second DVD-Video zone directories respectively; the method comprising the steps of: identifying the registers used by at least one of the first and second data; allocating use of the registers to at least one of the first and second data according to said identifying; and creating data associated with video manager information (VMGI) of the DVD-video disc image data to accommodate at least one of the first and second DVD-Video zones.

Advantageously, multiple authoring tools can be used to create or to author a single DVD-Video disc image or project.

A further advantage of embodiments of the present invention is that multiple authors can collaborate to work on the same project, either using separate copies of the

same authoring tool, or using different authoring tools with the end products being merged using embodiments of the present invention.

Preferred embodiments provide a method comprising the
5   step of collating the first and second data to produce DVD-Video data.

At least one of the first and second data comprises at least one of a Group of Picture, a Video Object, a Video Object Set, a Video Object Unit, a Cell, Program,
10 Part_of_Title, Program Chain, Title, Navigation Pack, Video Pack, Audio Pack or DVD-Video disc image data.

Preferably, embodiments provide a method in which the step of creating comprises creating menu data of video manager menu data (video_ts.vob) to access at least one of
15 the first and second data.

Preferred embodiments provide a method further comprising the step of establishing a backup copy of the data associated with the video manager information.

Embodiments provide a method in which the step of
20 establishing a backup copy of the data associated with the video manager information comprises the step of creating VMGI backup information (video_ts.bup).

Preferred embodiments provide a method in which the first and second data were created using respective,
25 different, authoring tools or by different authors using the same tool.

Embodiments provide a method further comprising, prior to the step of identifying, the step of determining

whether or not at least one of the first and second data has associated copy protection.

Embodiments are provided in which the step of creating the first data using a respective authoring tool and performing the steps of any preceding claim using that respective authoring tool.

It will be appreciated that embodiments also provide a system for implementing methods described in this specification. Suitably, for example, an aspect of embodiments of the present invention provides a system for merging first and second data associated with first and second DVD-Video zone directories respectively; the system comprising an identifier to identify registers or resources used by at least one of the first and second data; an allocator to allocate use of the registers or resources to at least one of the first and second data according to an output of the identifier; and a creator to create data associated with video manager information (VMGI) of the DVD-video disc image data to accommodate at least one of the first and second DVD-Video zones. A still further aspect of embodiments of the present invention provides a system for merging first and second data associated with first and second DVD-Video zone directories respectively; the system comprising means to identify the registers used by at least one of the first and second data; means to allocate use of the registers to at least one of the first and second data according to said identifying; and means to create data associated with video manager information (VMGI) of the DVD-video disc image data to accommodate at least one of the first and second DVD-Video zones.

A further aspect of embodiments of the present invention provides a method for merging first and second video data (for example, VTSs); the method comprising the steps of: assessing potential use of a predeterminable

5   resource by at least one of the first and second video data; allocating use of the predeterminable resource to at least one of the first and second video data according to the step of assessing; collating the first and second video data to create DVD-Video data; and creating data

10   associated with video manager information (for example, VMGI) of the DVD-Video data to accommodate at least one of the first and second video data.

Embodiments provide a data processing method in which the predeterminable resource is at least one of GPRM

15   registers, titles and part of titles.

Embodiments can be realised in the form of software. The software can be carried using any appropriate medium such as, for example, optical media like DVD, CD-ROM, magnetic media or using devices like ROMs or other

20   programmable devices.   Suitably, embodiments provide a computer program comprising executable code to implement a method or system as described or claimed in this specification.   Preferred embodiments provide a computer program product comprising storage storing such a computer

25   program.

Further aspects of embodiments of the present invention provide a method for merging first and second DVD-Video zone directories (VIDEO_TS); the method comprising the steps of: identifying the use of GPRM

30   registers by at least one of the first and second DVD-Video zones; allocating use of the GPRM registers to at

least one of the first and second DVD-Video zones
according to said identifying; collating the first and
second DVD-Video zones to create DVD-video disc image
data; and creating data associated with video manager
5   information (VMGI) of the DVD-video disc image data to
accommodate at least one of the first and second DVD-Video
zones.

Brief Description of the Drawings

10   Embodiments of the present invention will now be
descried, by way of example only, with reference to the
accompanying drawings in which:
        Figure 1 is an overview of an authoring method
according to a preferred embodiment;
15   Figure 2 is a schematic diagram showing a simple
abstraction of a desired audiovisual product;
        Figure 3 shows in more detail a component used as part
of the abstraction of Figure 2;
        Figure 4 illustrates an example prior art authoring
20 method compared with an example preferred embodiment;
        Figure 5 depicts another example embodiment of the
present authoring method using components and transitions;
        Figure 6 shows the example of Figure 5 in a tabular
format;
25   Figure 7 is an overview of a method for evaluating
components and transitions;
        Figure 8 depicts evaluation of components in more
detail;
        Figure 9 shows evaluation of transitions in more
30 detail;
        Figure 10 illustrates a portion of an expanded data
structure during evaluation of components and transitions;

Figure 11 is an overview of a preferred method for creating DVD-video structures from an expanded data structure;

Figure 12 shows a step of creating DVD video structure
5   locations in more detail;

Figure 13 depicts a step of creating DVD-video compatible data structures in more detail;

Figure 14 shows schematically a file structure illustrating the format of the data units forming a DVD-
10   video disc image;

Figure 15 illustrates schematically incorporation of video title sets into a DVD-Video disc image having a video manager and accompanying video title sets;

Figure 16 depicts a flowchart for merging DVD-Video
15   according to a first embodiment;

Figure 17 illustrates an embodiment of the present invention for incorporating a video manager and associated video title sets into further video title sets; and

Figure 18 shows a flowchart for merging DVD-Video
20   according to a second embodiment.

Detailed Description of the Preferred Embodiments

Figure 1 shows an overview of an authoring method according to a preferred embodiment of the present
25   invention. The embodiments of the present invention are applicable when authoring many types of audiovisual content or products, and in particular when complex navigational structure or content are involved.

As one example, embodiments of the present invention are applicable to authoring of video-on-demand products delivered remotely from a service provider to a user, such as over a computer network or other telecommunications
5   network. Here, the embodiments of present invention are especially useful in authoring interactive products, where user choices and responses during playback of the product dictate navigational flow or content choices.

10   As another example, embodiments of the present invention are particularly suitable for use in the authoring of an audiovisual product or audio visual content compliant with a DVD-video specification. This example will be discussed in more detail below in order to
15   illustrate the preferred arrangements of present invention. The audiovisual product or content can be, for example, recorded onto a medium such as an optical disk or magnetic medium. The DVD-video specification defines a series of data objects that are arranged in a hierarchical
20   structure, with strict limits on the maximum number of objects that exist at each level of the hierarchy. Hence, in one preferred embodiment of the present invention it is desired to create an audiovisual product or audiovisual content which meets these and other limitations of the
25   specification. In particular it is desired that the resultant audiovisual product or content will play on commonly available DVD players. However, it is also desired to create the audiovisual product or content having a complex navigational structure, to increase a
30   user's enjoyment of the product, and in order to allow the creation of new categories of audiovisual products.

In the field of DVD-video, audiovisual content is considered in terms of audio-visual assets (also called AV assets or presentation objects). According to the DVD-video specification each AV asset contains at least one

5 video object, zero or more audio objects, and zero or more sub-picture objects. That is, a section of video data is presented along with synchronised audio tracks and optional sub-picture objects. The current DVD-video specification allows up to eight different audio tracks

10 (audio streams) to be provided in association with up to nine video objects (video streams). Typically, the video streams represent different camera angles, whilst the audio streams represent different language versions of a soundtrack such as English, French, Arabic etc. Usually,

15 only one of the available video and audio streams is selected and reproduced when the DVD-video product is played back. Similarly, the current specification allows up to thirty-two sub-picture streams, which are used for functions such as such as language subtitles. Again,

20 typically only one of the sub-picture streams is selected and played back to give, for example, a movie video clip with English subtitles from the sub-picture stream reproduced in combination with a French audio stream. Even this relatively simple combination of video, audio and

25 sub-picture streams requires a high degree of co-ordination and effort during authoring to achieve a finished product such as a feature movie. Hence, due to the laborious and expensive nature of the authoring process there is a strong disincentive that inhibits the

30 development of high-quality audiovisual products or content according to the DVD-video specification. There is then an even stronger impediment against the development of audiovisual products or content with complex

navigational flow or using high numbers of individual raw content objects.

Conveniently, the authoring method of embodiment of the present invention are implemented as a program or a suite of programs. The program or programs are recorded or stored on or in any suitable medium, including a removable storage such as a magnetic disk, hard disk or solid state memory card, or as a signal modulated onto a carrier for transmission on any suitable data network, such as the Internet.

In use, the authoring method is suitably performed on a computing platform, like a general purpose computing platform such as a personal computer or a client-server computing network. Alternatively, the method may be implemented, wholly or at least in part, by dedicated authoring hardware.

As shown in Figure 1, the authoring method of the preferred embodiment of the present invention comprises three main stages, namely: creating a high-level abstraction (or storyboard) representing functional sections of a desired audiovisual product in step 101; automatically evaluating the high-level abstraction to create a fully expanded intermediate structure and a set of AV assets in step 102; and creating an output data structure compliant with a DVD-video specification using the expanded intermediate structure and AV assets in step 103. Preferably, the output data structure can then recorded onto a recording medium, such as, for example, a digital linear tape that can be used, to create a DVD-

video product using glass master created using the content
of the digital linear tape.

The method outlined in Figure 1 will now be explained
5   in more detail.

Firstly, looking at the step 101 of Figure 1, the
high-level abstraction is created by forming a plurality
of components that implicitly represent functional
10   elements of a desired DVD-video product or content, and a
set of transitions that represent movements, that is,
navigation, between the components that will occur during
playback.

15   Figure 2 is a schematic diagram showing a simple
abstraction of a desired audiovisual product or content.
In the example of Figure 2 there are three components 201,
linked by two transitions 202. The components 201
represent functional elements of the desired audiovisual
20   product, where one or more portions of AV content
(combinations of video clips, audio clips, etc) are to be
reproduced during playback. The transitions 202 indicate
legitimate ways of moving from one component to another
during playback.   In the example of Figure 2, the
25   transitions 202 are all explicitly defined.   Suitably,
each transition 202 is associated with an event 203, which
indicates the circumstances giving rise to that
transition. An event 203 is a triggering action such as
the receipt of a user command, or the expiry of a timer,
30   that influences movement through the sections of AV
content during playback. Referring to Figure 2, starting
from a particular component A, and given all possible
actions, exactly one event 203 will be satisfied, allowing

a transition 202 from the current component A to a next component B or C.

The preferred embodiments provide three different types of component. These are an information component, a choice component and a meta-component.

An information component represents what will in due course become a single AV asset in the desired audiovisual product. Suitably, an information component simply comprises a reference to a raw content object or collection of raw content objects (i.e. raw video and audio clips, image stills or other digital content) that will be used to create an AV asset in the audiovisual product. For example, an information component refers to a welcome sequence that is displayed when the DVD-video product is played in a DVD-video player. The same welcome sequence is to be played each time playback begins. It is desired to display the welcome sequence, and then proceed to the next component. An information component (which can also be termed a simple component) is used principally to define presentation data in the desired DVD-video product.

A choice component represents what will become a plurality of AV assets in the desired audiovisual product. In the preferred embodiment, the choice component (alternately termed a multi-component) comprises a reference to at least one raw content object, and one or more parameters. Here, for example, it is desired to present a welcome sequence in one of a plurality of languages, dependent upon a language parameter. That is, both a speaker's picture (video stream) and voice track

(audio stream) are changed according to the desired
playback language. Conveniently, a choice component is
used to represent a set of desired AV assets in the
eventual audiovisual product or content, where a value of

5   one or more parameters is used to distinguish between each
member of the set. Hence, a choice component represents
mainly presentation data in a desired DVD-video product or
content, but also represents some navigational structure
(i.e. selecting amongst different available AV assets

10   according to a language playback parameter).

A meta-component comprises a procedurally-defined
structure representing a set of information components
and/or a set of choice components, and associated

15   transitions. Conveniently, a meta-component may itself
define subsidiary meta-components. A meta-component is
used principally to define navigational structure in the
desired audiovisual product by representing other
components and transitions.

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Figure 3 shows a choice component or information
component 201 in more detail. The component is reached by
following one of a set of incoming transitions 202,
labelled Ti(1…n), and is left by following one of a set of

25   outgoing transitions To(1…m). The set of incoming
transitions 202 might comprise one or more than one
incoming transition. The set of outgoing transitions
might comprise one or more than one outgoing transition.

30   The component 201 is defined with reference to zero or
more parameters 301, which are used only during the
authoring process. However, the component 201 may also be
defined with reference to zero or more runtime variables

302. Each variable 302 records state information that can be read and modified within the scope of each component, during playback of the audiovisual product or content such as in a standard DVD player. Conveniently, the component

5   201 is provided with a label 303 for ease of handling during the authoring process.

The component 201 contains references to one or more items of content 304. The items of content are raw

10 multi-media objects (still picture images, video clips, audio clips, text data, etc.) recorded in one or more source storage systems such as a file system, database, content management system, or asset management system, in any suitable format such as, for example, .gif, .tif,

15 .bmp, .txt, .rtf, .jpg, .mpg, .qtf, .mov, .wav, .rm, .qtx, amongst many others. It will be appreciated that these raw content objects are not necessarily at this stage in a format suitable for use in the DVD-video specification, which demands that video, audio and sub-picture objects

20 are provided in selected predetermined formats (i.e. MPEG).

Each component 201 uses the references as a key or index which allows that item of content to be retrieved

25 from the source storage systems. The references may be explicit (e.g. an explicit file path), or may be determined implicitly, such as with reference to values of the parameters 301 and/or variables 302 (i.e. using the parameters 301 and/or variables 302 to construct an

30 explicit file path).

Conveniently, the component 201 also preferably comprises a reference to a template 305. The template 305

provides, for example, a definition of presentation, layout, and format of a desired section of AV content to be displayed on screen during playback. A template 305 draws on one or more items of content 304 to populate the

5 template. Typically, one template 305 is provided for each component 201. However, a single template 305 may be shared between a number of components 201 or vice versa. A template 305 is provided in any suitable form, such as, for example. As an executable program, a plug-in or an

10 active object. A template is conveniently created using a programming language such as C++, Visual Basic, Shockwave or Flash, or by using a script such as HTML or Python, amongst many others. Hence, it will be appreciated that a template allows a high degree of flexibility in the

15 creation of AV assets for a DVD-video product or content. Also, templates already created for other products (such as a website) may be reused directly in the creation of another form of audiovisual product or content, in this case a DVD-video product content.

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The parameters 301, runtime variables 302, content items 304 and template 305 together allow one or more AV assets to be produced for use in the desired audiovisual product. Advantageously, creating a component 201 in this

25 parameterised form allows a number, which might be a large number, large plurality of AV assets to be represented simply and easily by a single component.

To illustrate the power and advantages of creating

30 components 201 and transitions 202 as described above, reference will now be made to Figure 4 which compares a typical prior art method for authoring an audiovisual product or content against preferred embodiments of the

present invention. In this example, it is desired to develop an audiovisual product which allows the user to play a simple quiz game.

In Figure 4a, each AV asset 401 which it is desired to present in the eventual audiovisual product must be created in advance and navigation between the assets defined using navigation links represented by arrows 402. Here, the game involves answering a first question and, if answered correctly, then answering a second question. The answer to each question is randomised at runtime using a runtime variable such that one of answers A, B and C is correct, whilst the other two are incorrect. In this simple example of Figure 4a it can be seen that a large number of assets need to be created, with an even greater number of navigational links. Hence, the process is relatively expensive and time consuming, and is prone to errors.

Figure 4b shows an abstraction, using components and transitions as described herein, for an equivalent quiz game. It will be appreciated that the abstraction shown in Figure 4b remains identical even if the number of questions increases to ten, twenty, fifty or some other number of questions, whereas the representation in Figure 4a becomes increasingly complex as each question is added.

Figure 5 shows another example abstraction using components and transitions. Figure 5 illustrates an example abstraction for an audiovisual product or content that will contain a catalogue of goods sold by a retail merchant. A welcome sequence is provided as an information component 201a. Choice components 201b are

used to provide a set of similar sections of AV content such as summary pages of product information or pages of detailed product information including photographs or moving video for each product in the catalogue. Here, the

5 catalogue contains, for example, of the order of one thousand separate products, each of which will result in a separate AV asset in the desired DVD-video product. Meta-components 201c provide functions such as the selection of products by category, name or by part code.

10 These meta-components are procedurally defined.

Figure 6 shows a tabular representation for the abstraction shown in schematic form in Figure 5.

15 In use, the authoring method and apparatus suitably presents a convenient user interface for creating components and transitions of the high-level abstraction. Ideally, a graphical user interface is provided allowing the definition of components, transitions and events,

20 similar to the schematic diagram of Figure 5. Most conveniently, the user interface provides for the graphical creation of components such as by drawing boxes and entering details associated with those boxes, and defining transitions by drawing arrows between the boxes

25 and associating events with those arrows. Alternatively, a tabular textual interface is provided similar to the table of Figure 6.

Referring again to Figure 1, the abstraction created

30 in step 101 is itself a useful output. The created abstraction may be stored for later use or may be transferred to another party for further work. However, in most cases the authoring method is used to automatically

create a final audiovisual product or content, such as a DVD-video product, from the abstraction.

Referring to Figure 1, the method optionally includes
5   the step 104 of checking for compliance with a DVD specification. It is desired to predict whether the resulting DVD-video product will conform to a desired output specification, in this case the DVD-video specification. For example, the DVD-video specification
10 has a hierarchical structure with strict limits on a maximum number of objects that may exist at each level, and limits on the maximum quantity of data that can be stored on a DVD-video disc.

15   In one embodiment, the checking step 104 is performed using the created components 201 and transitions 202. As discussed above, the components 201 contain references to raw AV content objects 304 and templates 305, and authoring parameters 301, 302, that allow AV assets to be
20 produced. The checking step 104 comprises predicting a required number of objects at each level of the hierarchical structure, by considering the number of potential AV assets that will be produced given the possible values of the authoring parameters (i.e.
25 authoring-only parameters 301 and runtime variables 302), and providing an indication of whether the limits for the maximum number of objects will be exceeded. Similarly, where a component defines a set of similar AV assets, then it is useful to predict the physical size of those assets
30 and to check that the audiovisual product or content is expected to fit within the available capacity of a DVD disc. Advantageously, the conformance check of step 104 is performed without a detailed realisation of every AV

asset, whilst providing an operator with a reasonably accurate prediction of expected conformance. If non-conformance is predicted, the operator may then take steps, at this early stage, to remedy the situation. As a result, it is possible to avoid unnecessary time and expense in the preparation of a full audiovisual product which is non-conformant.

As shown in Figure 1, in step 102 the components 201 and transitions 202 of the high level abstraction 200 are automatically evaluated and expanded to create AV assets and an intermediate data structure of nodes and links. Figure 7 shows the step 102 of Figure 1 in more detail.

The components 201 and transitions 202 may be evaluated in any order. However, but it is convenient to first evaluate the components and then to evaluate the transitions. Ideally, any meta-components in the abstraction are evaluated first. Where a meta-component results in new components and transitions, these are added to the abstraction until all meta-components have been evaluated, leaving only information components and parameterised choice components.

An expanded intermediate data structure is created to represent the abstract components 201 and transitions 202 in the new evaluated form. This expanded data structure comprises branching logic derived from the events 203 attached to the transitions 202 (which will eventually become navigation data in the desired audiovisual product or content) and nodes associated with AV assets derived from the components 201 (which will eventually become presentation data in the audiovisual product or content).

However, it is not intended that the expanded data structure is yet in a suitable form for creating an audiovisual product in a restricted format such as a DVD-video product, since at this stage there is no mapping

5   onto the hierarchical structure and other limitations of the DVD-video specification.

Figure 8 shows step 701 of Figure 7 in more detail, to explain the preferred method for evaluating the components

10   201. As shown in Figure 8, each information component 201a and each choice component 201b is selected in turn in step 801. Each component 201 is evaluated to provide one or more AV assets in step 802. In an information component, this evaluation comprises creating an AV asset from the

15   referenced raw content objects 304. In a choice component, this evaluation step comprises evaluating a template 305 and one or more raw content objects 304 according to the authoring parameters 301/302 to provide a set of AV assets. Suitably, a node in the expanded data structure

20   is created to represent each AV asset, at step 803. At step 804, entry logic 132 and/or exit logic 134 is created to represent a link to or from each node such that each AV asset is reached or left under appropriate runtime conditions.

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Figure 9 shows a preferred method for evaluating transitions in step 702 of Fig.7. Each transition 202 is selected in any suitable order in step 901. In step 902 the conditions of the triggering event 203 associated with

30   a particular transition 202 are used to create entry and/or exit logic for each node of the expanded data structure. In step 903, explicit links are provided between the nodes.

Figure 10 is a schematic illustration of a component 201 during evaluation to create a set of nodes 110 each associated with an AV asset 120, together with entry logic
5   132 and exit logic 134, defining movement between one node 110 and the next. The entry logic 132 and exit logic 134 reference runtime variables 302 which are available during playback (e.g. timer events, player status, and playback states), and the receipt of user commands. Conveniently,
10   the evaluation step consumes each of the authoring-only parameters 301 associated with the abstract components 201, such that only the runtime variables 302 and runtime actions such as timer events and user commands remain.

15   Referring again to Figure 1, a conformance checking step 105 may, additionally or alternatively to the checking step 104, be applied following the evaluation step 102. Evaluation of the abstraction in step 102 to produce the expanded data structure 100 allows a more
20   accurate prediction of expected compliance with a particular output specification. In particular, each node of the expanded data structure represents one AV asset, such that the total number of AV assets and object locations can be accurately predicted, and the set of AV
25   assets has been created, allowing an accurate prediction of the capacity required to hold these assets. Conveniently, information about conformance or non-conformance is fed back to an operator. Changes to the structure of the product can then be suggested and made in
30   the abstraction to improve compliance.

Referring to Figure 1, in step 103 the expanded data structure from step 102 is used to create an audiovisual

product according to a predetermined output format, in this case by creating specific structures according to a desired DVD-video specification.

5   Figure 11 shows an example method for creation of the DVD video structures. In step 1101, the nodes 110 in the expanded data structure are placed in a list, such as in an order of the abstract components 201 from which those nodes originated, and in order of the proximity of those

10   components to adjacent components in the abstraction. As a result, jumps between DVD video structure locations during playback are minimised and localised to improve playback speed and cohesion.

15   Each node is used to create a DVD video structure location at step 1102. Optionally, at step 1103 if the number of created DVD video structure locations exceeds the specified limit set by the DVD-video specification then creation is stopped at 1104 and an error reported.

20   Assuming the number of structures is within the specified limit then DVD video compatible data structures are created at step 1105. Finally, a DVD video disc image is created at step 1106. Conveniently, commercially available tools are used to perform step 1106 and need not

25   be described in detail here.

      Step 1102 is illustrated in more detail in Figure 12. In this example variable T represents a number of a video title set VTS (ie. from 1-99) whilst variable P represents

30   a program chain PGC (ie. from 1-999) within each video title set. As shown in Figure 12, the nodes 110 of the expanded data structure 100 are used to define locations in the video title sets and program chains. As the

available program chains within each video title set are consumed, then the locations move to the next video title set. Here, many alternate methods are available in order to optimise allocation of physical locations to the nodes

5 of the expanded data structure.

Step 1105 of Figure 11 is illustrated in more detail in Figure 13. Figure 13 shows a preferred method for creating DVD-video compatible data structures by placing

10 the AV assets 120 associated with each node 110 in the structure location assigned for that node and substituting links between the nodes with explicit references to destination locations. At step 1307 this results in an explicit DVD compatible data structure which may then be

15 used to create a DVD disc image. Finally, the DVD disc image is used to record a DVD disc as a new audiovisual product.

Referring to figure 14 there is shown schematically a

20 file structure 1400 of a DVD-video file system. It can be appreciated that a root node 1402 has a DVD-Video zone 1404. The DVD-Video zone 1404 has a folder or directory named VIDEO_TS 1405 comprising information in the form of video manager information 1408. The video manager

25 information 1408 comprises data representing or associated with a video manager (VMG) or from which such a VMG can be derived. The video manager information 1408 has associated video manager menu information 1410 that, typically, contains the initial menu presented to a user

30 upon inserting a DVD into a DVD player. Also illustrated is the conventional video manager information (VMGI) back-up 1412. The DVD-Video zone 1404 comprises data 1414 representing video title sets (VTS1 to VTS99) that contain

control data, menu data, title VOBs (Video Objects comprising MPEG encoded video data, audio data, sub-picture data and navigation information) and backup information. It can be appreciated that a number of video
5   title sets VTS1 to VTS99 comprising such data are illustrated. The data 1414 representing each video title set of such video title sets VTS1 to VTS99 are represented by data arranged in groups of files. It will be appreciated that two groups of data 1414a and 1414b,
10   representing two video title sets VTS1 and VTS99, are illustrated.

The groups of data 1414a and 1414b representing the video title sets VTS1 to VTS99 comprise files 1416 and 1426 containing, or representing, video title set
15   information (VTSI), having control data, files 1418 and 1428 representing, or containing, video object sets for menu, if appropriate, of corresponding video title sets VTS1 to VTS99, files representing 1420 to 1422 and 1430 to 1432, or containing data for, a number of title video
20   objects (Title VOBs), which contain the video, audio, sub-picture data and navigation data, and files 1424 and 1434 containing data representing video title set back-up information (VTSI Backup). The file system 1400 illustrated in figure 14 is used by the presentation
25   engine and the navigation manager to render video and audio in accordance with signals received from a remote control when playing a DVD.

Referring to figure 15, there is shown schematically a process 1500 for merging DVD-Video data according to a
30   first embodiment. It can be appreciated that a first set of DVD-video data 1502 comprises a video manager 1504 and associated first and second video title sets 1506 and

1508. It will be appreciated that the first set 1502 of DVD-Video data has been shown as comprising two VTSs. However, any other number, up to a maximum of 99 VTSs with current technology, could equally well be used by embodiments. In the example illustrated, it is desired to incorporate a second set 1510 of video title sets, comprising, for illustrative purposes only, two video title sets 1512 and 1514 authored by a different authoring tool or a different author using the same authoring tool to the one used to produce the first set of DVD-video image data 1502. It will be appreciated that any other number of VTSs could be merged into the first set 1502 according to requirements, up to a maximum of 99 according to the limits of current technology. It will be appreciated that the plurality of components described above comprises a component representing or associated with the first set 1502 DVD-video data. Furthermore, in preferred embodiments, the first 1502 set of DVD-video data is an embodiment of a raw content object described above, while the second set 1510 of DVD-video data is preferably native to, that is, produced by, the tool performing the incorporation.

Referring to figure 16, there is shown a flowchart 1600 for incorporating the second set 1510 of video title sets 1512 and 1514 into the DVD-Video data 1502 according to an embodiment. At step 1602, a determination is made as to whether or not the second set 1510 of DVD-Video data or the first set 1502 of DVD-Video image data has been subjected to some form of content protection such as, for example, the protection provided by a Content Scrambling System (CSS). If the determination at step 1602 is that content protection (CSS) is effective, processing

terminates with an optional message being output at step 1604 indicating that the two sets of DVD-Video data 1502 and 1510 cannot be merged due to content protection being effective.

5   However, if the determination at step 1602 is that content protection is not effective, or has not been applied to either of the DVD-Video data sets 1502 and 1510, a check is made at step 1606 to determine if the video contained within the video title sets 1506, 1508, 10   1512 and 1514 is compatible, that is, a check is performed to ensure that they all conform to one of the NTSC or PAL standards. If the determination at step 1606 shows that the video contained within, or represented by, the video title sets 1506, 1508, 1512 and 1514 are incompatible, a 15   message is output at step 1608 to that effect and processing terminates.

However, if the video contained within, or represented by, the video title sets 1506, 1508, 1512 and 1514 are compatible, processing proceeds to step 1609a, where it is 20   determined if the total number of VTSs in the resulting merged DVD-video data would exceed a predetermined limit, which is 99 according to current technology, but which could equally well be some other limit. If it is determined that the total number of VTSs would exceed the 25   predetermined limit, a message to that effect is output at step 1609b. If it is determined that the total number of VTSs would not exceed the predetermined limit, processing proceeds to step 1610 where the use of the general parameters registers (GPRMs) of the first 1506 and second 30   208 video title sets of the first set 1502 of DVD-Video data is determined.

At step 1612, the GPRM registers not used by the first 1506 and second 1508 video title sets are deemed to be available for use by the first 1512 and second 1514 video title sets of the second set 1510 of DVD-Video data.

5   The first 1512 and second 1514 video title sets of the second set 1510 of DVD-Video image data are incorporated into or integrated into the first set 1502 of DVD-Video image data at step 1614. The video manager 1504 is amended, at step 1616, to include references to the newly 10   incorporated first 1512 and second 1514 video title sets to allow those video title sets to be accessed in an appropriate manner from a menu, if provided, associated with the video manager 1504. It will be appreciated that such references represent embodiments of the plurality of 15   transitions described above, which would map to corresponding links during expansion. Steps 1614 and 1616 might be realised, for example, by copying files representing, or associated with, the first 1512 and second 1514 VTSs into an output area used by an authoring 20   tool for authoring operations, and by adding to the VMG 1504 of the first set of DVD-Video data 1502 (contained in VIDEO_TS.IFO and VIDEO_TS.BUP) attributes of, or associated with, the new VTSs 1512 and 1514.

It will be appreciated by those skilled in the art 25   that step 1614 comprises identifying the appropriate entry points and exit points for the first 1512 and second 1514 video title sets of the second set 1510 of DVD-Video image data. Still further, the incorporation performed at step 1614 comprises the step of modifying the exit points of 30   the first 1512 and second 1514 video title sets of the second set 1510 of DVD-video image data so that control is returned to the video manager 1504 as appropriate. It

will be appreciated by those skilled in the art that the entry and exit points are embodiments of the transitions described above and that they will be mapped to links of the expanded intermediate data structure described above.

5   Referring to figure 17, there is shown schematically the construction 1700 of DVD-Video data from a first set 1702 of DVD-Video data produced using a respective authoring tool and a second set 1704 of DVD-Video data produced using a different authoring tool or using a copy
10   of the same authoring tool used by a different author. It can be appreciated that the first set 1702 of DVD-Video data comprises first 1706 and second 1708 video title sets. Again, it will be appreciated that two VTSs have been shown for illustrative purposes only. Any number of
15   VTSs could be processed in practice, subject to limits imposed by technical standards that might prevail from time to time. The second set 1704 of DVD-Video data comprises a video manager 1710 and respective first 1712 and second 1714 video title sets. Once again, two VTSs
20   have been used for illustrative purposes only. In the embodiment shown, the second set 1704 of DVD-Video data is incorporated into the first set 1702 of DVD-video image data. Again, in preferred embodiments, it will be appreciated that the first 1702 set of DVD-video data is
25   an embodiment or realisation of a raw content object described above, which can be represented by an associated component of the plurality of components, while the second set of video data is native to, that is, produced by the tool used to perform the incorporation.

30   Figure 18 shows a flowchart 1800 for giving effect to the combination or incorporation illustrated by the embodiment shown in figure 17. A determination is made at

step 1802 as to whether or not content protection is effective in respect of either of the first set 1702 or second set 1704 of DVD-Video data. If it is determined that such content protection is effective, processing
5   passes to step 1804 where a message indicating that the DVD-Video data sets 1702 and 1704 cannot be merged or combined due to content protection being effective.

If the determination at step 1802 is that content protection is not effective, processing proceeds to step
10   1806 where it is determined whether or not the video represented by, or contained within, the video title sets 1706, 1708, 1712 and 1714 are compatible, that is, whether or not they are all NTSC video or all PAL video, for example. If the determination at step 1806 is that the
15   video represented by, or contained within, the video title sets 1706 to 1714 are incompatible, a message is output to that effect at step 1808 together with an indication that the merging or combining process cannot be completed.

If the determination at step 1806 is that the video
20   standards are compatible, processing proceeds to step 1809a, where it is determined if the total number of VTSs in the resulting merged DVD-video data would exceed a predetermined limit, which is 99 according to standards applicable to current technology, but which could equally
25   well be some other limit. If it is determined that the total number of VTSs would exceed the predetermined limit, a message to that effect is output at step 1809b. If it is determined that the total number of VTSs would not exceed the predetermined limit, processing proceeds to
30   step 1810 where the use of the GPRM registers of the first set 1702 of DVD-video data is determined. The registers not used by the first set 1702 of DVD-Video data are

identified at step 1812 as being available for use by the second set 1704 of DVD-Video data. The entry points in the first set 1702 of DVD-Video data are determined, that is, the entry points for the first 1706 and second 1708
5   video title sets are determined at step 1814. Furthermore, at step 1816, the exit points for the first 1706 and second 1708 video title sets of the first set 1702 of DVD-Video image are identified.

The first set 1702 of DVD-Video data is copied into,
10   or combined with, the second set 1704 of DVD-Video data at step 1818. All exit points in the VTSs of the first set 1704 of DVD-Video data are replaced with navigation data that returns control to the video manager 1710 of the second set 1704 of DVD-Video data at step 1820.

15   At step 1822, the navigation data associated with the video manager 1710 for accessing the first 1706 and second 1708 video title sets of the first set 1702 of DVD-video image data are included in the video manager 1710 or, more specifically, in the VMGI of the video manager 1710
20   (contained in VIDEO_TS.IFO).

It will be appreciated by one skilled in the art that modifying the VMGI comprises establishing appropriate start sector addresses to allow a navigation manager to identify the start sector addresses or entry points for
25   the newly added video title sequences. In practice such modifications entail doing a search-and-replace operation. The instructions that cause control to jump from one place to another are relative, if the jump is within a current VTS, and absolute if the jump is outside a current VTS.
30   Thus, any jumps to outside of a current VTS must be reassigned to fit in with the new combined structure.

Again, it will be appreciated that the entry and exits points, that is, navigation data, represent embodiments of the links of the expanded intermediate data structure described above that are derived from corresponding

5   transitions. In the above embodiments, the incorporation is performed preferably using the authoring tool used to produce the second set 1510 or 1704 of DVD-Video data.

The DVD authoring method and apparatus described above have a number of advantages. Creating components that

10 represent parameterised sections of audio visual content allow many individual AV assets to be implicitly defined and then automatically created. Repetitive manual tasks are avoided, which were previously time consuming, expensive and error-prone. The authoring method and

15 apparatus significantly enhance the range of features available in existing categories of audiovisual products or content such as movie presentations. They also allow new categories of audiovisual products or content to be produced. These new categories include both entertainment

20 products or content such as quiz-based games and puzzle-based games, as well as information products such as catalogues, directories, reference guides, dictionaries and encyclopaedias. In each case, the authoring method and apparatus described herein allow full use of the video

25 and audio capabilities of DVD specifications such as DVD-video. A user may achieve playback using a standard DVD player with ordinary controls such as a remote control device. A DVD-video product having highly complex navigational content is readily created in a manner which

30 is simple, efficient, cost effective and reliable.

Although a few preferred embodiments have been shown and described, it will be appreciated by those skilled in the art that various changes and modifications might be made without departing from the scope of the invention, as

5   defined in the appended claims.

The audiovisual content comprises at least any one of data representing audiovisual content, DVD video disc image data or other data compliant with the DVD

10 specification or a medium storing such data

Although the above embodiments have been described with reference to the product or content being playable by a "standard DVD player", it will be appreciated that other

15 players can equally well be accommodated such as, for example, software players, set-top boxes or other means of processing or otherwise rendering audiovisual products using hardware or software or a combination of hardware and software.

20

The reader's attention is directed to all papers and documents which are filed concurrently with or previous to this specification in connection with this application and which are open to public inspection with this

25 specification, and the contents of all such papers and documents are incorporated herein by reference.

All of the features disclosed in this specification (including any accompanying claims, abstract and drawings) and/or all of the steps of any method or process so

30 disclosed may be combined in any combination, except combinations where at least some of such features and/or steps are mutually exclusive.

Each feature disclosed in this specification (including any accompanying claims, abstract and drawings) may be replaced by alternative features serving the same, equivalent or similar purpose, unless expressly stated
5   otherwise. Thus, unless expressly stated otherwise, each feature disclosed is one example only of a generic series of equivalent or similar features.

The invention is not restricted to the details of any foregoing embodiments. The invention extends to any novel
10   one, or any novel combination, of the features disclosed in this specification (including any accompanying claims, abstract and drawings), or to any novel one, or any novel combination, of the steps of any method or process so disclosed.

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